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ELECTRONIC SURFACE MOUNT PACKAGE

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CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of copending application entitled ELECTRONIC SURFACE MOUNT PACKAGE, Serial No. 08/513,573, filed August 10, 1995 and assigned to the same Assignee as the present application.

BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

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It is widely known in the local area magnetic industry that when surface mount toroidal magnetics which are encapsulated in hard plastics go through infra-red soldering processes, the magnetic components (ferrite) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which makes the part unusable. In view of the foregoing, it would be highly desirable to provide an improved electronic surface mount package which avoids the cracking and expansion problems described above.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound and soldered. The wire which is wound and soldered around each terminal pin/post is from a respective toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents cracking and allows for the toroidal expansion. The present invention also includes a reinforcement beam that is disposed laterally or sidewise across the bottom of the package to provide extra

support in the mechanical strength of the case.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

Figure 1 shows an electronic surface mount package in three-dimensional view according to the present invention.

Figure 2 shows a wound toroid transformer.

Figure 3 shows the connection of the toroid transformer of Figure 2 within the electronic surface mount package of Figure 1.

Figure 4 shows the electronic surface mount package of Figure 1 after wire terminations have been soldered.

Figure 5 and 6 show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

Figure 7 shows a close-up of the pin configuration of Figure 1 and how it is molded inside the wall of the body of the package.

Figure 8 shows wire wrapped around the pin or post of

Figure 7.

Figures 9A -9D show end, top, side, and bottom views of electronic surface mount package according to the present invention.

Figure 10 shows a bottom view of a 40 pin package according to the present invention.

Figure 11 shows an enlarged sectional view of Figure 10 illustrating a reinforcement beam.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

As will be described in more detail below, the present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The

present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

As described above, it is known that when the parts go through an infra-red soldering process, the magnetic components (ferrite toroids) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than trying to contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material"). The wires from the toroids are wound around and soldered to the pin-posts. This construction solves the cracking and expansion problems described above, as will now be described in conjunction with Figures 1-11.

Figure 1 shows an electronic surface mount transformer package or case 10 in three-dimensional view. Figure 1 shows a cut-away of the empty case 10 with pins 14 molded into the case

10, together a the notched post 12 upon which a wire is wound. Post 12 has an hour-glass shape which facilitates the winding of wire around post 12, as will be described. Typically, tin-lead plated copper alloy terminals are molded into the wall of the package 10. The outer portion of the package 10 is formed to meet specified footing requirements. The inner post 12 serves as a terminal for internal wire termination use. The package material is made of type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

Figure 2 shows a wound toroid transformer 20 with wire 22 wrapped around the transformer 20. The toroid core is typically made of ferrite material and the winding of wire 22 is done manually with fine insulated magnet wire.

Figure 3 shows a cut-away of the molded part with the toroid 20 mounted inside and showing the wire 22 as it is then attached to post 14. The wires 22 are pulled with minimum tension and wrapped around the terminal post 14 for two to two and a half turns. This operation is done when the case has been placed bottom side up.

Figure 4 shows a silicon compound 30 poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) 32 and the package has been properly cleaned. The case 10 is then filled with soft silicone material (preferably a soft epoxy type material) to protect the transformer and to meet environmental requirements.

Figures 5 and 6 show the relationships between the safe

guard (stand off) 34 and package's foot seating plane and inner terminal posts 12a. Figure 5 shows the standoff 34, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post 12 does not touch the PC board, and so the end standoffs 34 do not allow that to happen. In a preferred embodiment, post 12 is oriented substantially perpendicular to, but does not touch, PC board.

Figure 6 shows the distance in relationship between the end of the post 12 and where the PC board 36 is located and also where the standoff 34 ends. The PC board 36 would be at the base of the foot.

In Figure 6, the typical clearance of 0.015 inches from the safe guard 34 to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard 34 and terminal post 12 to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package 10, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The leaf frame pins are injection molded into the body and which allows for an exposed notched post upon which the wire is wound from the toroidal transformer. This allows for

the wires to be separated from pin to pin, and for soldering to be much more efficient.

Figure 7 shows a closeup of the hour-glass shaped pin 12 and how pin 12 is molded inside the wall of the body and also the notch effect 40 of the pin 12. The post 14 is notched so that the wires are kept away from another, post to post, which is very desirable. The separation is desirable so as to avoid arcing.

Figure 8 shows the wire 22 wrapped around the pin or post 12.

Figures 9A-9D show end, top, side, and bottom views, respectively, of the electronic surface mount package 10. The embodiment shown in Figures 9A-9D provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal re-flow processes with low cost, easy manufacturing, and high reliability.

In the industry, most manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with hard epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled tends to cause the two pieces to separate. The base separates from the top, and as a result, can end up cracking. The present invention provides a one-piece open construction (an open bottom) only with the soft silicon filling to protect the toroid. The case is open at the bottom, thus allowing the toroids to expand naturally without cracking

the body of the part.

Figure 10 shows a bottom view of a 40 pin package 30 which includes pins 32 which includes a reinforcement beam 36 laterally disposed across the bottom of the case or package 30 reinforcement beam 36 provides extra support for improving the mechanical strength of the package 30.

Figure 11 shows an enlarged sectional view of the package 30 of Figure 10 in which the reinforcement beam 36 is disposed laterally or sidewise across the bottom of the package or case 30. The 40 pin surface mount package shown in Figures 10 and 11 include the reinforcement beam 36 which provides extra support to the mechanical strength of the package 30. This provides for an improved mechanically stable package 30 which when undergoing an IR (infrared) re-flow process and also maintain the coplanarity of the leads or pins 32 shown in Figure 11.

Although Figure 11 shows one reinforcement beam 36 laterally disposed across the bottom of the case or package 30, it would be apparent to one of ordinary skill in the art that additional reinforcement beams can be located on the bottom of the case or package 30 as the situation warrants.

It should become apparent that various desirable features of the present invention have been shown and described. In the present invention, the pin termination is not flush mounted but rather extends from the bottom of the package. Further, the termination is wound and soldered to the extended pin-post assembly, as shown in Figures 1 and 3-8. The use of a soft

silicon type material (such as soft epoxy) to carry the toroid transformers within the case or package acts to encapsulate or support the toroid transformer within the case or package.

The present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

It is widely known that when the toroidal magnetics are mounted in hard plastic packages, the infra-red soldering processes cause the magnetic components (ferrite) to expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material") such that when the wires are wound

around and soldered to the pin-posts, the cracking and expansion problems described above are avoided.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.